

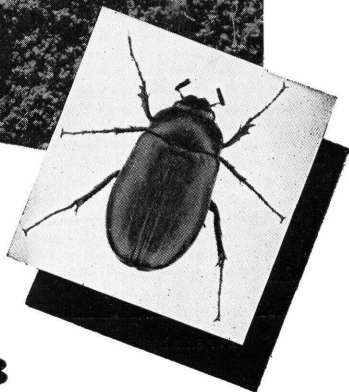
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Control of Common White Grubs

in Cereal and Forage Crops



Farmers' Bulletin No. 1798

U. S. DEPARTMENT OF AGRICULTURE

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CONTROL OF COMMON WHITE GRUBS IN CEREAL AND FORAGE CROPS

By the Entomology Research Division, Agricultural Research Service

COMMON WHITE GRUBS, the young of May Beetles, frequently destroy large acreages of many farm crops by eating the roots and other underground parts of the plants. In some years losses caused by damage to corn, timothy, and po-

and Indiana. These grubs are also serious pests of grass pastures and nursery plantings. They may also damage lawns and golf courses. The adult beetles eat the leaves of many kinds of trees; sometimes they strip the timber on farm wood lots.



FIGURE 1.—A corn hill destroyed by white grubs.

tatoes in the North Central States alone reach several million dollars. From 12 to 17 grubs may be found in a single hill of corn (fig. 1). Such an infestation may destroy the crop completely. In recent years damage to soybeans (fig. 2) or to corn following soybeans in a rotation has been a problem in Illinois

Outbreaks of white grubs have occurred in some of the North Central States every third year for nearly 50 years. During the early outbreaks injury was reported from almost every section north of the Ohio River and westward to South Dakota, but in recent years the damage has been less general.

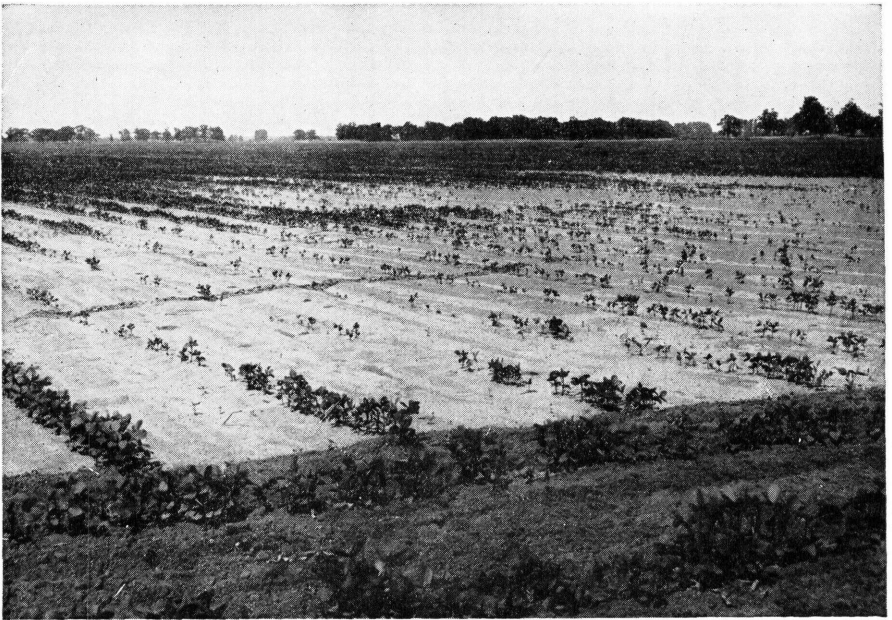


FIGURE 2.—Soybeans severely damaged by white grubs in Jasper County, Indiana.

BROODS OF MAY BEETLES

There are more than 100 different kinds of May beetles. Some of them are more injurious than others. While white grubs are troublesome every year, in the region where grubs do the most damage, most of the injurious species have a 3-year life cycle which accounts for the 3-year cycle of outbreaks. However, a brood of adults emerges in each year of the cycle. These broods have been designated as A, B, and

C. Brood A (fig. 3), adults of which will appear in 1959, 1962, and every 3 years thereafter, is by far the most abundant. The most severe grub damage will occur the year *after* that in which heavy beetle flights occur, or in 1960, 1963, and every 3 years thereafter. Brood B is usually unimportant, but larvae from Brood C (fig. 4) may cause damage in some areas in 1959, 1962, and every 3 years thereafter.

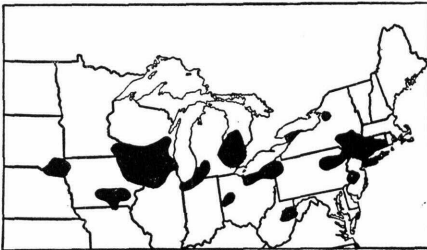


FIGURE 3.—Map showing districts of greatest abundance of brood A of May beetles.

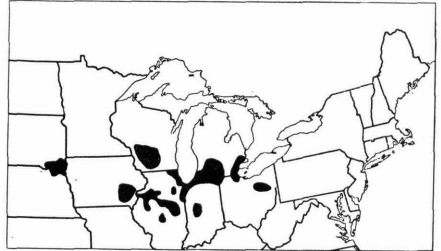


FIGURE 4.—Map showing districts of greatest abundance of brood C of May beetles.

LIFE HISTORY OF MAY BEETLES

May beetles emerge from the soil in the spring and lay their eggs a few inches below the surface (fig. 5). They place the eggs within balls of earth that they have formed and held together with a sticky se-

cretion. After 3 or 4 weeks the eggs hatch into white grubs.

The grubs feed for the first season on decaying vegetable matter in the soil and also attack living roots. Late in the fall they burrow deeper

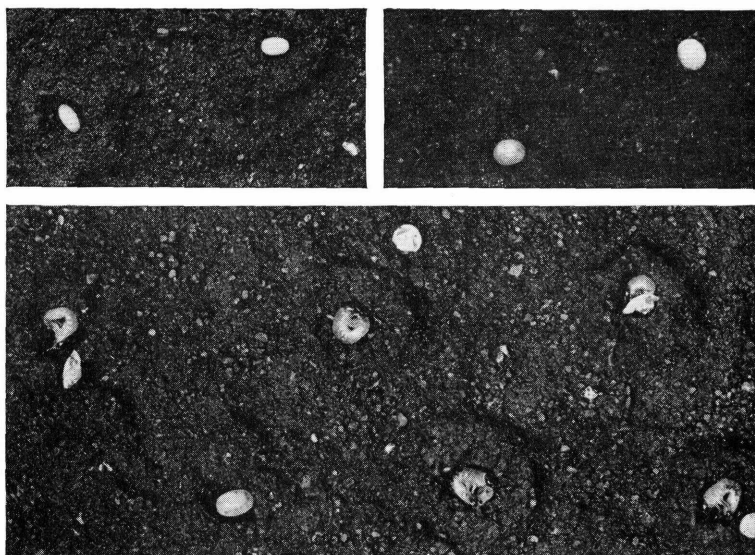


FIGURE 5.—Eggs of May beetles in their soil cells: Upper left, immediately after deposition; upper right, 6 or 7 days later. Below, white grubs hatching.

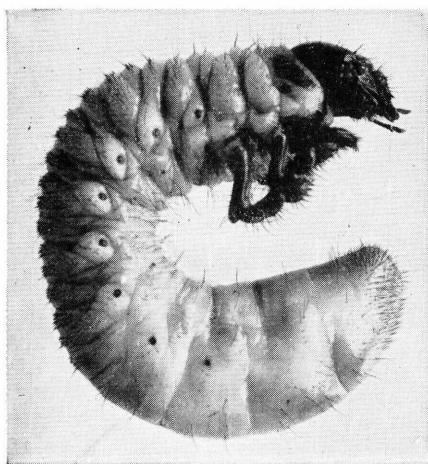


FIGURE 6.—A full-grown white grub, enlarged.

into the ground, where they remain inactive during the winter. The following spring they come up near the surface again and feed on the roots of plants. They do their greatest damage in this their second year. In the fall they again go deep into the soil, to return in the spring, some of them to feed on the plant roots until about June. By this time the grubs are full-grown (fig. 6). Then they prepare earthen cells in the ground in which to change to the inactive pupal stage (fig. 7). A few weeks later the pupae change to adult beetles, but they remain in the pupal cells over another winter, and then emerge from the ground to lay eggs for the next generation. (See fig. 10.)

The time when the beetles appear depends on the latitude. In Indiana and southern Wisconsin they are most abundant during the last 2 weeks of May, but they may be found any time between the first of May and the middle of July. In more southern latitudes they appear about a month earlier. Farther north, particularly in Canada, they are most numerous in June and are called June beetles.

The beetles eat the leaves of many kinds of trees, especially oak (figs. 8 and 9), elm, hickory, ash, poplar,

willow, locust, hackberry, walnut, and pine. Some species also feed on nonwoody plants, particularly such weeds as curly dock, cinquefoil, and wild sunflower.

In recent years one species known scientifically as *Phyllophaga rugosa* has become abundant in the central Corn Belt area. The adults feed on the leaves of soybeans and place their eggs around the roots of soybeans. The larvae do extensive damage to soybean fields. They belong to the Brood C group.

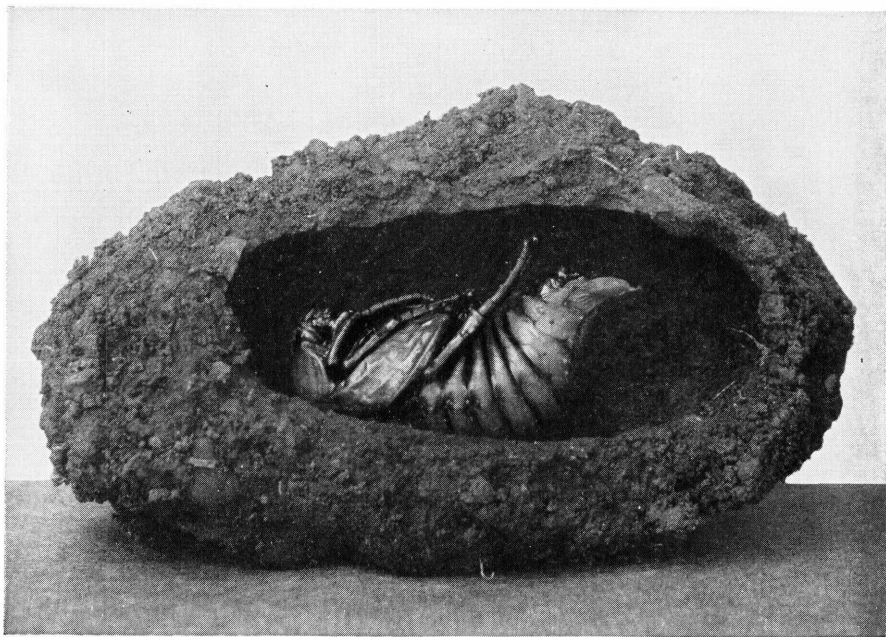


FIGURE 7.—A May beetle pupa in its cell.

GRUBS LIKELY TO BE MISTAKEN FOR WHITE GRUBS

Many people believe that the white grubs seen in the field are the same as similar grubs often found in manure heaps and rotten logs. The grubs of May beetles are not known to breed in manure or any other kind of refuse. The grubs found most commonly in manure in the Northern States are the larvae

of certain brown beetles which, like the May beetles, are attracted to lights, but do not feed on plant foliage. The grubs of May beetles have a double row of spines along the under side of the last body segment, which helps to distinguish them from other grubs living in similar habitats.



FIGURE 8.—A bur oak wood lot defoliated by May beetles.

Another grub often mistaken for that of a May beetle is the larva of the green June beetle, known to scientists as *Cotinis nitida*, which sometimes injures grass and other vegetation, including alfalfa, in the

Southern States and along the Atlantic coast as far north as Long Island, N. Y. Recently it has been a serious pest of Ladino clover in southeastern Virginia. This grub seems to prefer soils fertilized with

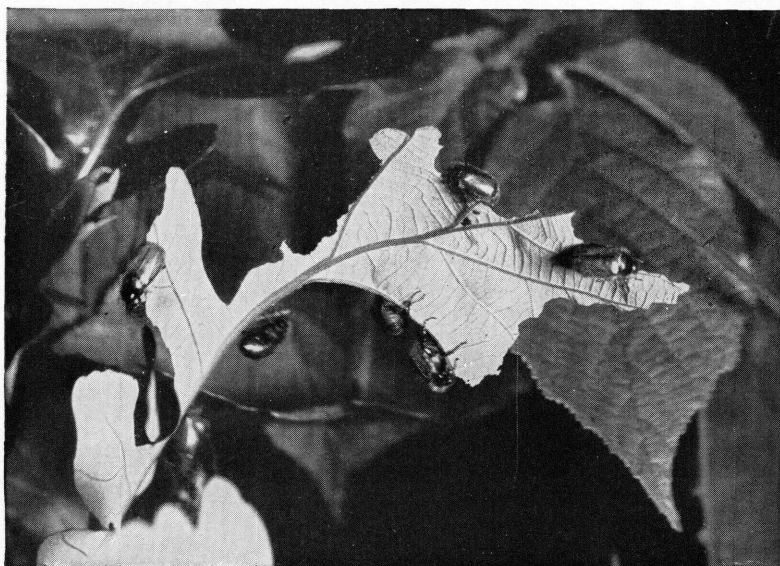
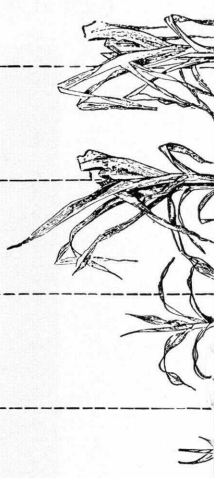
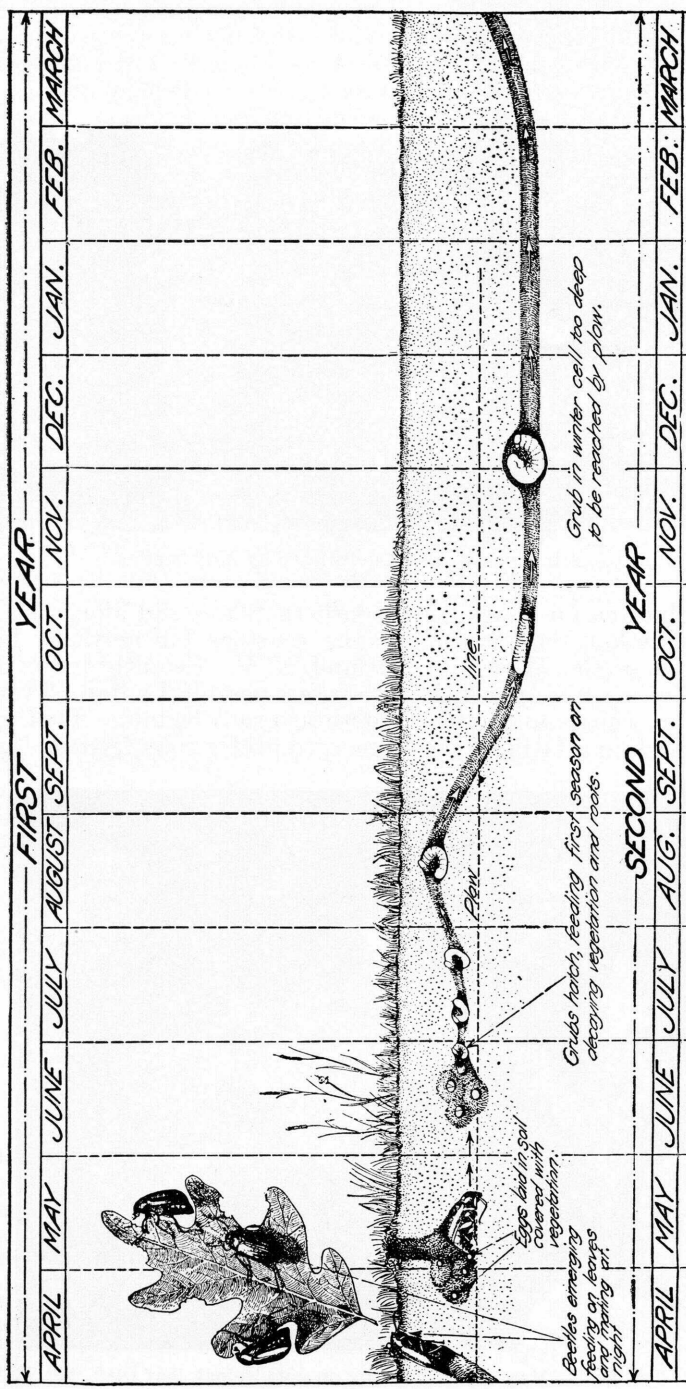


FIGURE 9.—May beetles feeding on a white oak leaf.



animal manures. Unlike the common white grubs, it makes burrows that open at the soil surface. It has a peculiar habit of crawling on its back when placed on the ground. However, it is much less injurious to field crops than are the common white grubs. Occasionally it damages golf courses by making small mounds of earth, which interfere with play and cover the grass with mud during wet weather.

Two species of *Cyclocephala* have sometimes appeared in destructive numbers in lawns, grassy areas, and corn. These grubs can be recognized by their bluish cast and the irregular arrangement of the spines on the under side of the last body segment. Their life cycle is completed in 1 year. The adults appear in July, after the May beetles have disappeared, and they do not feed on the foliage of trees and shrubs as do May beetles.

Other kinds of grubs sometimes confused with larvae of the May beetles are those of the Japanese beetle, common in some sections of the Eastern States, and of the white-fringed beetle, found in the South-eastern States. The Japanese beetle grubs are smaller than the common white grubs. White-fringed beetle grubs are yellowish white and legless.

If in doubt as to what kind of grubs are present in your soil, submit specimens to your State agricultural experiment station for identification.

NATURAL ENEMIES

White grubs and May beetles are preyed upon by numerous birds, animals, and insects. Probably the most helpful in this respect are the birds, especially crows and grackles and, in some localities, gulls. Fields of timothy sod have been literally overturned by crows in their search for grubs and in some fields the

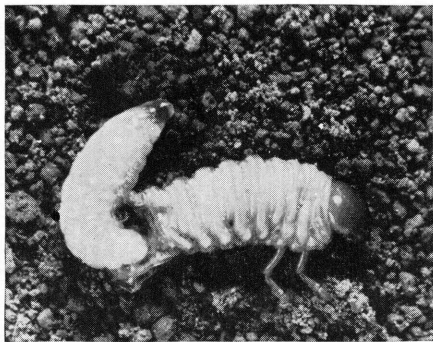


FIGURE 11.—Larva of a wasp attacking a white grub.

grubs have been almost exterminated by them. Grackles have often been observed following the plow, eagerly picking up every grub that was unearthed. All farm fowls eat these insects, but especially turkeys. Opposums and especially moles and skunks also feed on white grubs.

Among insect enemies of the grubs are certain wasps, bee flies, and robber flies. The wasp larvae (fig. 11), which feed on and destroy the grubs, when full-grown, form brown cocoons in the soil (fig. 12), which are frequently turned out by the plow. The robber fly larvae are

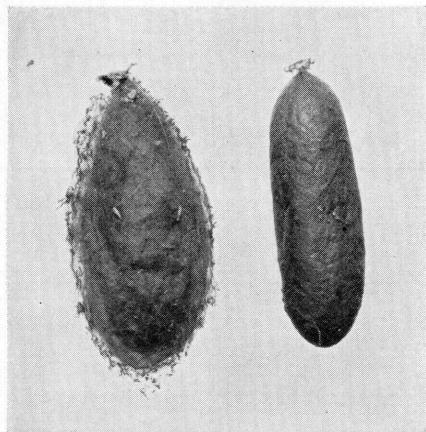


FIGURE 12.—Cocoons of *Tiphia* (left) and *Elis* (right) wasps, parasites of white grubs.

slender and shiny white and about $1\frac{1}{2}$ inches long when full-grown. The adults prey on other insects. Some parasitic flies attack the beetles depositing their eggs within the body of the beetle. The larva

hatching from the egg gradually kills the beetle.

Fungus diseases sometimes attack the grubs or beetles, and when conditions are favorable these diseases no doubt serve as natural checks.

WHERE TO LOOK FOR GRUBS

May beetles usually deposit their eggs in ground covered with vegetation near timber on the higher parts of the land. Therefore, you are most likely to find the grubs in sod on the higher parts of fields of timothy and bluegrass near wooded tracts, or in ground that was in one of these crops the previous year, or was covered with vegetation other than deep-rooted legumes during

the flight of the beetles. The species previously mentioned as feeding on soybeans is an exception. The short, dense growth of grass on lawns is also favored for egg laying. Sometimes infested turf rolled back like a carpet, exposes large numbers of grubs (fig. 13). As many as 11 grubs have been found in 1 square foot of soil.

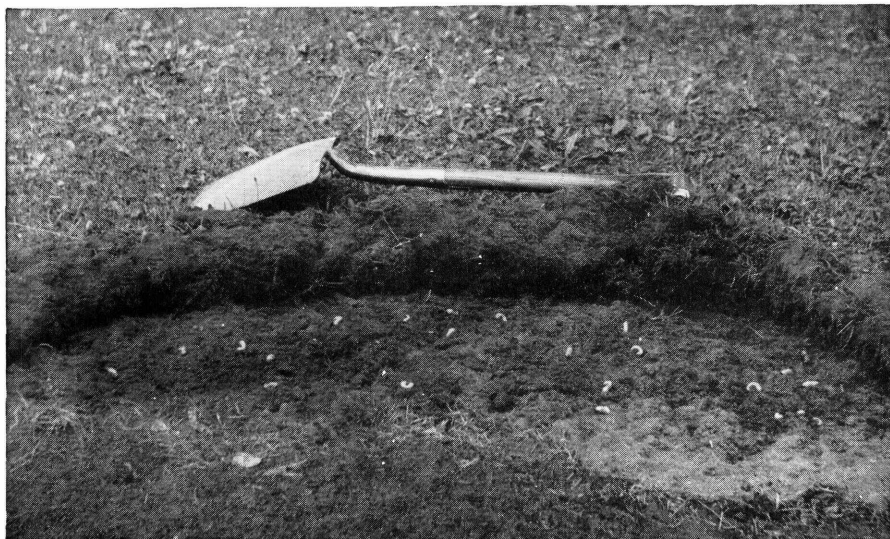


FIGURE 13.—A piece of sod overturned to show the white grubs underneath.

FARM PRACTICES THAT WILL CONTROL WHITE GRUBS

There are no satisfactory means of destroying the white grubs that are present in large fields of growing crops. However, certain farm practices, if carefully carried out, will greatly reduce the damage in succeeding years.

Cropping Practices

White grubs feed on a wide range of garden and field crops, as well as grasses and nursery plants. Some plants are severely damaged, others are occasionally attacked,

and some rarely show evidence of feeding. All crops, however, are more susceptible in the seedling stage.

Agricultural crops may be grouped as follows according to their susceptibility to attack:

Susceptible: Timothy, red top, Kentucky bluegrass, corn, soybeans, strawberries, and potatoes.

Moderately resistant: Barley, oats, wheat, rye, beans, turnips, and carrots.

Very resistant: White Dutch clover, red clover, alsike clover, peas, orchard grass, buckwheat, and sunflowers.

Extremely resistant: Alfalfa and sweetclover.

Crop damage can be reduced by using a rotation of resistant and susceptible crops—for example, a rotation of deep-rooted legumes such as alfalfa, sweetclover, or red clover, with corn, small grains, or grasses.

To gain the most benefit, sow the legumes in the years when beetle flight is heaviest, which is when the beetles of brood A emerge. In these years the eggs are laid, small larvae appear early in the summer but do little damage, and if the stand of legumes is clean—free from weeds and grass upon which the grubs may feed—most of the grubs will die before winter.

In general, in areas where grubs are prevalent, do not plow sod fields for planting any susceptible crop in the year following a major flight of May beetles. This is the year in which the grubs feed most heavily, and they cause damage to the new crop, even to seedlings of legumes. In this year plow and plant to crops only fields that were in legumes or some clean-cultivated crop such as corn or potatoes. If you must plow grassland in a year of major beetle flight, plant only resistant crops. Sod may contain a high grub population.

Where it is impossible to follow such a rotation, grow deep-rooted

legumes as much as possible and follow them with clean-cultivated crops, but practice strip-cropping or terracing where erosion is a problem.

When white grub damage occurs in fields in which the rotation for several years has consisted of soybeans and corn, use a longer rotation including other crops.

Every farmer whose lands are subject to grub attack should learn the years in which major beetle flights occur, the years in which the grubs do the most damage, and the particular fields on his farm that are more commonly infested. He should give these fields special care and crop them in a rotation designed primarily to control the grubs. Some fields that are lightly or only rarely infested do not need to be placed in such a rotation.

Plowing as a Control Measure

Ordinary spring and fall plowing will not control white grubs. Most of the spring plowing is completed before many of the grubs are within plowing depth, and fall plowing is done after many of them have descended below that depth. Moreover, few of the grubs uncovered are cut by the plow, and many of them escape into moist soil.

Plowing late in the spring or early in the fall may destroy some of the grubs that are near the surface, if the plowing is shallow and done when the topsoil is hot and dry. Shallow plowing at such times followed by disking has been suggested as a control measure. The ground should be disked several times, each disking being crosswise to the preceeding one. If the soil is hot and dry, exposure to the heat will quickly kill many grubs, but if it is moist and cool the disking must be more thorough, for only the grubs crushed or cut with the plow or disks will be killed.

Renovation of Pastures

Grub damage is generally slight in permanent bluegrass pastures that are well cared for, improved by the use of proper fertilizers, and not overgrazed. Pastures on rich, moist bottom lands usually show little injury. On the other hand, egg laying by May beetles may be heavy in pastures on hilly, rocky land near woods. On such land the soil is likely to be thin and dry, especially when feeding by grubs is heaviest (fig. 14).

Pastures impoverished by overgrazing, lack of soil fertility, and grub damage may be renovated in a short time. You can obtain instructions applicable to your particular area from your county agent or State agricultural experiment station, but in general the renovating process includes the following steps:

(1) Prepare a good seedbed by tearing up the sod with a disk, spring-tooth harrow, or field cultivator. Do this once or twice in the fall after the grass has stopped growing and again in the spring before growth starts.

(2) Apply fertilizer and lime in the amounts that soil tests show to be needed.

(3) Sow a mixture of legumes and firm the seedbed with a cultipacker or roller. A mixture of 12 to 15 pounds of common biennial white sweetclover and 5 pounds of red clover per acre has been found suitable for some localities.

(4) Fence off the renovated area so that grazing can be regulated. Moderate grazing may be permitted during July and August of the year of seeding, when bluegrass pastures are usually unproductive. However, withhold grazing during September and October, or until growth has been retarded by frost. Light grazing thereafter will cause little damage to the legumes. The bluegrass will come back vigorously after the legumes have been established.



FIGURE 14.—A bluegrass meadow seriously damaged by white grubs.

CONTROL OF GRUBS WITH INSECTICIDES

There are no satisfactory means of destroying the white grubs that are present in large fields of growing crops. However, if such crops as corn or soybeans are severely damaged early enough in the season to replant, it may be profitable to do so after applying insecticides as suggested in the following paragraphs.

During the last few years excellent control of white grubs has been secured with insecticides applied at rates which make such control economically sound. Insecticides most widely used are: Aldrin, heptachlor, dieldrin, and chlordane. The rates at which they need to be applied will depend upon the stage of the grubs, the length of time protection is desired, and the type of soil.

For large grubs the second or third year after they have hatched from the eggs 2 pounds of dieldrin or 3 pounds of aldrin or heptachlor and 10 pounds of chlordane are required for adequate control. In addition, **these materials must be applied 2 or 3 weeks before the crop to be protected is planted**, otherwise the large grubs may seriously damage the young seedlings since the large grubs often continue

feeding for some time after being poisoned.

Newly hatched, first-year grubs can be readily controlled by broadcast applications of 1 pound of dieldrin, 1½ pounds of aldrin or heptachlor, or 2 pounds of chlordane per acre. When applied at these rates, these materials will provide complete control of the newly hatched grubs for at least 2 years. The materials may be applied as sprays or in granules and should be disked into the soil immediately after application. In muck soils at least twice the amounts of materials given above may be necessary for good results.

Caution. In using any insecticide for white grub control, follow carefully all directions given on the container. Do not inhale the dust or spray. Wear gloves while doing the work and change your clothes if you spill any of the insecticide on them. Store insecticides in plainly labeled containers, away from food, and out of reach of children and pets.

Do not feed any vegetation contaminated with these insecticides to dairy animals or to animals being fattened for slaughter.

CONTROL OF MAY BEETLES

As little as 2½ pounds of aldrin or heptachlor per acre applied as broadcast sprays have resulted in almost complete mortality of very heavy populations of May beetles as they emerge from the soil. In fact, rates of insecticides recommended for broadcast application—i. e., 1 pound of dieldrin, 1½ pounds of aldrin or heptachlor, or 2 pounds of chlordane—appear to give a high rate of mortality of beetles emerging from the soil.

It is usually not practical to attempt control of adult May beetles

feeding on trees or shrubbery, although both lead arsenate and DDT have been used for that purpose. For a spray use 2 pounds of lead arsenate plus 1 pound of wheat flour or the recommended amount of a good proprietary adhesive, or 8 ounces of a 50-percent DDT wettable powder, in 25 gallons of water. Although it is less satisfactory than a spray, you may apply DDT as a 5-percent dust.

In some parts of the South, as in southern Texas, certain species of the May beetles are wingless. They

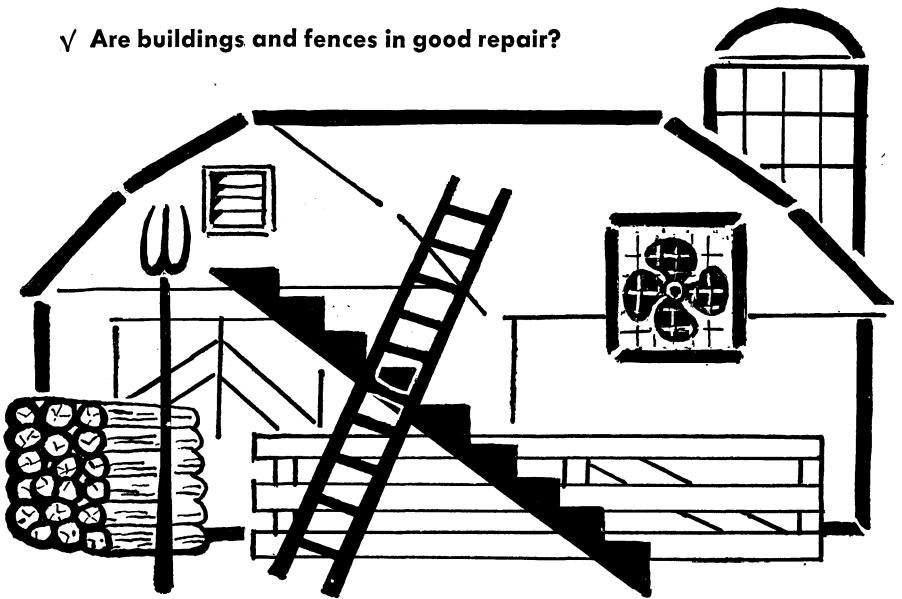
crawl from field to field and seriously damage field and garden crops. You can control such beetles with a poisoned bait. Mix thoroughly 20 pounds of wheat bran and 1 pound of paris green and add sufficient water to dampen the mixture thoroughly. Broadcast at the rate of 7 to 10 pounds per acre just before dark.

When the beetles are moving from one field to another it is some-

times practical to trap them in deep furrows plowed across their path. Smooth the bottoms of such furrows and leave the sides loose to prevent the beetles from climbing out. Post holes may be dug in the bottom of the furrow at intervals of 15 to 20 feet into which the beetles fall; they can then be easily destroyed. Scatter the poisoned bait along the edges of the furrow to hasten the kill of beetles.

CHECK up on these accident hazards around your farm . . .

- ✓ **Is farmyard clear of tools, broken glass, loose strands of barbed wire, nail-studded boards?**
- ✓ **Are water tanks, cisterns, and wells protected?**
- ✓ **Are ladders and steps in good repair?**
- ✓ **Are pitchforks, rakes, shovels, and other sharp tools kept in racks?**
- ✓ **Are electric circuits and appliances in good condition?**
- ✓ **Is unused lumber carefully stacked?**
- ✓ **Are buildings and fences in good repair?**



**clean up your farm
to make it attractive and SAFE**